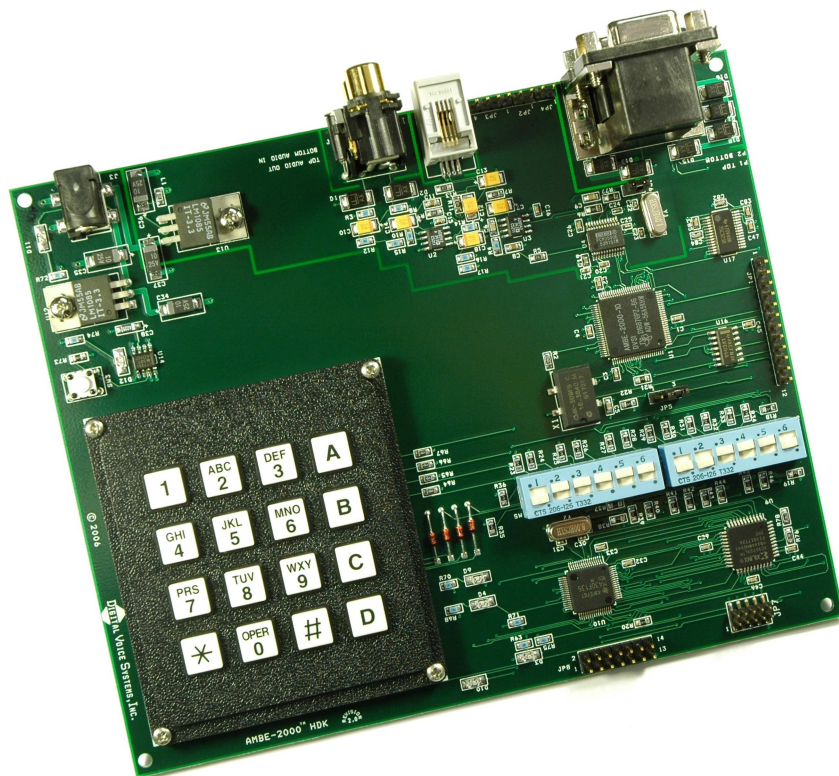




AMBE-20x0™-HDK
Development Board
Version 2.3
07, September

User's Manual
Preliminary

AMBE-20x0™-HDK Development Board
User's Manual
Version 2.3
07, September

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Digital Voice Systems, Inc
234 Littleton Road
Westford, MA 01886

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AMBE-20x0™-HDK Development Board END USER License Agreement

*** Important Read Carefully ***

This end user license agreement is a legal agreement between the customer (the END USER) and Digital Voice Systems, Inc. (DVSI) covering the terms and conditions under which DVSI's proprietary software, documentation and other material which may be provided with the AMBE-20x0™-HDK Development Board is licensed to the END USER.

1.0 Preliminary Statements and Definitions

1.1 "END USER" shall mean the person and/or organization to whom the AMBE-2000™ Vocoder Chip and/or AMBE-20x0™-HDK Development Board was delivered or provided to as specified in the purchase order or other documentation. In the event that the END USER transfers his rights under this license to a third party as specified in section 2.2, then this third party shall become an "END USER".

1.2 Digital Voice Systems, Inc. (DVSI) has developed a voice coding method and algorithm (the "Technology") based on the Advanced Multi-Band Excitation ("AMBE®") voice coder. The technology codes speech at bit rates of 2.4 to 9.6 kilobits per second (kbps) including error correction bits.

1.3 "AMBE® Voice Compression Software" shall mean the speech coding software and/or firmware integrated into the AMBE-2000™ Vocoder chip integrated circuit.

1.4 "Voice Codec" shall mean the AMBE-2000™ Vocoder Chip integrated circuit, the AMBE® Voice Compression Software, firmware and associated documentation, including modifications, enhancements and extensions made by or for Digital Voice Systems, Inc. (DVSI) and including circuit diagrams, timing diagrams, logic diagrams, layouts, operating instructions and user manuals.

1.5 DVSI represents that it owns certain "Proprietary Rights" in the Technology and the AMBE® Voice Compression Software, including patent rights in the Technology, and patent rights, copyrights, and trade secrets in the AMBE® Voice Compression Software.

2.0 License Granted

2.1 Subject to the conditions herein and upon initial use of the AMBE-2000™ Vocoder Chip and/or AMBE-20x0™-HDK Development Board, DVSI hereby grants to END USER a non-exclusive, limited license to use the AMBE® Voice Compression Software in machine readable form solely on the AMBE-2000™ Vocoder Chip. Title to the AMBE® Voice Compression Software remains with DVSI. No license is granted for use of the AMBE® Voice Compression Software on other than the AMBE-2000™ Vocoder Chip. No license, right or interest in any trademark, trade name or service mark of DVSI is granted under this Agreement.

2.2 END USER shall not copy, extract, de-compile, reverse engineer or disassemble the AMBE® Voice Compression Software contained in the AMBE-2000™ Vocoder Chip.

3.0 Transfer of License

3.1 The END USER shall have the right to transfer the AMBE-2000™ Vocoder Chip and/or AMBE-20x0™-HDK Development Board and all rights under this Agreement to a third party by either (i) providing the third party with a copy of this Agreement or (ii) providing the third party with an agreement written by the END USER (hereinafter "END USER Agreement") so long as the END USER Agreement is approved in writing by DVSI prior to transfer of the AMBE-2000™ Vocoder Chip and/or AMBE-20x0™-HDK Development Board. The END USER Agreement shall contain comparable provisions to those contained herein for protecting the Proprietary Information from disclosure by such third party. Third parties shall agree to accept all the terms and conditions under either Agreement or the END USER Agreement.

4.0 Term and Termination

4.1 This Agreement is effective upon initial delivery of the Voice Codec and shall remain in effect until terminated in accordance with this agreement.

4.2 This Agreement shall terminate automatically without notice from DVSI if END USER fails to comply with any of the material terms and conditions herein. END USER may terminate this Agreement at any time upon written notice to DVSI certifying that END USER has complied with the provisions of Section 3.3.

4.3 Upon termination of this Agreement for any reason, END USER shall: (i) return all AMBE-2000™ Vocoder Chips and/or AMBE-20x0™-HDK Development Boards purchased or acquired, or in Licensee's possession, to DVSI; (ii) have no further rights to any AMBE® Voice Compression Software or the Technology without a separate written license from DVSI; (iii) discontinue all use of the AMBE-2000™ Vocoder Chips and/or AMBE-20x0™-HDK Development Boards;

5.0 Payments

5.1 In consideration of the materials of the AMBE-20x0™-HDK Development Board, and in consideration of the license and rights in the AMBE® Voice Compression Software granted by DVSI, and in consideration of DVSI's performance of its obligations hereunder, END USER agrees to pay to DVSI the fee specified in DVSI's invoice.

6.0 Proprietary Notices

6.1 END USER shall not remove any copyright or proprietary notice on the AMBE-2000™ Vocoder Chip or on the AMBE® Voice Compression Software and/or AMBE-20x0™-HDK Development Board.

7.0 Proprietary Information

7.1 The parties agree that the AMBE® Voice Compression Software and/or AMBE-20x0™-HDK Development Board shall be considered Proprietary Information.

7.2 Except as otherwise provided in this Agreement, END USER shall not use, disclose, make, or have made any copies of the Proprietary Information, in whole or in part, without the prior written consent of DVSI.

8.0 Limited Warranty

8.1 DVSI warrants the AMBE-20x0™-HDK Development Board to be free from defects in materials and workmanship under normal use for a period of ninety (90) days from the date of delivery.

8.2 Except as stated in Section 7.1, the AMBE-20x0™-HDK Development Board is provided "as is" without warranty of any kind. DVSI does not warrant, guarantee or make any representations regarding the use, or the results of the use, of the Voice Codec with respect to its correctness, accuracy, reliability, correctness or otherwise. The entire risk as to the results and performance of the Voice Codec and/or AMBE-20x0™-HDK Development Board is assumed by the END USER. After expiration of the warranty period, END USER, and not DVSI or its employees, assumes the entire cost of any servicing, repair, replacement, or correction of the Voice Codec and/or AMBE-20x0™-HDK Development Board.

8.3 DVSI represents that, to the best of its knowledge, it has the right to enter into this Agreement and to grant a license to use the AMBE® Voice Compression Software and/or AMBE-20x0™-HDK Development Board to END USER.

8.4 Except as specifically set forth in this Section 7.0, DVSI makes no express or implied warranties including, without limitation, the warranties of merchantability or fitness for a particular purpose or arising from a course of dealing, usage or trade practice, with respect to the Voice Codec and/or AMBE-20x0™-HDK Development Board. Some states do not allow the exclusion of implied warranties, so the above exclusion may not apply to END USER. No oral or written information or advice given by DVSI or its employees shall create a warranty or in any way increase, the scope of this warranty and END USER may not rely on any such information or advice. The limited warranties under this section 7.0 give END USER specific legal rights, and END USER may have other rights that vary from state to state.

9.0 Limitation of Liability

9.1 In no event shall DVSI be liable for any special, incidental, indirect or consequential damages resulting from the use or performance of the Voice Codec and/or AMBE-20x0™-HDK Development Board whether based on an action in contract, tort (including negligence) or otherwise (including, without limitation, damages for loss of business profits, business interruption, and loss of business information), even if DVSI or any DVSI representative has been advised of the possibility of such damages.

9.2 Because some states do not allow the exclusion or limitation of liability for consequential or incidental damages, the above limitations may not apply to END USER.

9.3 DVSI's maximum liability for damages arising under this Agreement shall be limited to 20% (twenty percent) of the fees paid by END USER for the particular Voice Codec and/or AMBE-20x0™-HDK Development Board which caused the damages or that is the subject matter of, or is directly related to, the cause of action.

10.0 Taxes

10.1 All payments required under Section 4.0 or otherwise under this Agreement are exclusive of taxes and END USER agrees to bear and be responsible for the payment of all such taxes (except for taxes based upon DVSI's income) including, but not limited to, all sales, use, rental receipt, personal property or other taxes which may be levied or assessed in connection with this Agreement.

11.0 Export

11.1 United States export laws and regulations prohibit the exportation of certain products or technical data received from DVSI under this Agreement to certain countries except under a special validated license. As of November 30, 1999 the restricted countries are: Libya, Cuba, North Korea, Iraq, Serbia, Taliban in Afghanistan, Sudan, Burma, Yugoslavia and Iran. The END USER hereby gives its assurance to DVSI that it will not knowingly, unless prior authorization is obtained from the appropriate U.S. export authority, export or re-export, directly or indirectly to any of the restricted countries any products or technical data received from DVSI under this Agreement in violation of said United States Export Laws and Regulations. DVSI neither represents that a license is not required nor that, if required, it will be issued by the U.S. Department of Commerce. Licensee shall assume complete and sole responsibility for obtaining any licenses required for export purposes.

12.0 Governing Law

12.1 This Agreement is made under and shall be governed by and construed in accordance with the laws of the Commonwealth of Massachusetts, except that body of law governing conflicts of law. If any provision of this Agreement shall be held unenforceable by a court of competent jurisdiction, that provision shall be enforced to the maximum extent permissible, and the remaining provisions of this Agreement shall remain in full force and effect.

Special Handling Instructions

To avoid damage from the accumulation of a static charge, industry standard electrostatic discharge precautions and procedures must be employed during handling and installation the AMBE-20x0™-HDK Development Board.

Read Instructions and Users Manual – All of the safe handling and operating instructions should be read before integration of the AMBE-20x0™-HDK Development Board begins. Failure to exercise reasonable care and to follow all instructions and heed all warnings may result in injury to property or to individuals.

Retain Instructions - The handling and operating instructions should be retained for future reference.

Follow Instructions - All operating and use instructions should be followed.

Storage

To insure maximum shelf life in long term storage, AMBE-20x0™-HDK Development board should be kept in an a static shield, moisture controlled package at <40°C and <90% Relative Humidity

Installation

Ventilation - The AMBE-20x0™-HDK Development Board unit should be situated so that its location or position does not interfere with proper ventilation and air circulation around the board.

Heat - The AMBE-20x0™-HDK Development Board unit should be situated away from devices that could act as a heat source such as an amplifier.

Power Sources - The AMBE-20x0™-HDK Development Board should be connected to a power source only of the type described in this Users Manual.

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SECTION 1

Introduction



General Information

The Digital Voice Systems, Inc. (DVS) AMBE-20x0™-HDK Development Board is an comprehensive, evaluation, test and development platform that helps product designers and manufacturing engineers gain experience with the low-bit-rate AMBE-2000™ and AMBE-2020™ Vocoder Chips. The AMBE-20x0™ HDK is ideal for comparing voice quality at various rates, analyzing the compressed voice data I/O stream and establishing interface requirements. This valuable knowledge gives engineers the insight required to start prototyping their own low-bit-rate communication systems quickly and easily thereby decreasing development costs and speed up a new product's time to market.

The AMBE-20x0™ HDK employs DVS's successful AMBE-2000™ vocoder chip that has been implemented in communication systems, including push-to-talk land mobile radio, and wireless telephony throughout the world. The AMBE-2000™ Vocoder Chip contains proprietary software that implements the Advanced Multi-Band Excitation AMBE® voice compression algorithm. The AMBE-2000™ Vocoder Chip is capable of speech and FEC data rates, from 2.0 Kbps to 9.6 Kbps (in 50 bps increments). This data rate flexibility makes the AMBE-20x0™ HDK a cost efficient design and development tool for high performance, low bandwidth voice communication applications.

AMBE-20x0™-HDK Development Board Features

- ✓ *Flexible Bit Rate Selection - Real Time, High Quality, Speech Compression Data rates from 2000 bps to 9600 bps.*
- ✓ *Straightforward Vocoder Configuration - Set-up via the on-board keypad, dipswitches or jumpers.*
- ✓ *Variety of Advanced Features - Soft decision FEC, Voice Activity Detection (VAD), adaptive Comfort Noise Insertion (CNI) and support for DTMF tones.*
- ✓ *Easy to duplicate design - schematic details, example microcontroller software and PLD code, provides engineers a detailed reference for designing custom circuits.*
- ✓ *Standard RS-232 asynchronous interface - provides a channel connection to another AMBE-20x0™ HDK or other RS-232 device for real-time communication.*
- ✓ *Single voltage design - minimizes circuit complexity because all AMBE-20x0™ HDK components are powered using a 3.3 Volt supply.*
- ✓ *16-bit high performance codec - provides quality analog audio I/O to an RCA jack (4-wire) and interface and to a handset (2-wire).*

Table 1 AMBE-20x0 HDK™ Features

Overview

The AMBE-20x0™ Hardware Development Kit (HDK) is designed to streamline the development of products engineered around the AMBE-2000™ Vocoder chip. The AMBE- 20x0™ HDK is a completely functional system from the analog audio interface to the digital channel interface. The straightforward design of the board provides a variety of user interfaces and test points that allow designers to rapidly prototype their own AMBE-2000™ designs.

Digital Voice Systems' AMBE-2000™ Vocoder Chip is the core of the AMBE-20x0™ HDK. All of the supporting chips on the board were chosen for their low cost, ease of use and wide availability. The control, I/O and timing of the board is handled by the Texas Instruments MSP430 microprocessor unit (MCU). The MSP-430 flash image is easily programmed using an MSP430-FET serial programmer a low cost development tool from Texas Instruments. The HDK incorporates a Xilinx programmable logic device (PLD). This is used for the serial to parallel conversion between the AMBE-2000™ Vocoder Chip and the MSP430 microcontroller. The PLD is programmed using a XILINX ISP.

The AMBE-20x0 HDK is designed to run in a standalone nature. The RS-232 interface can looped back so that the input goes through the AD/DA process the result is sent to the output. The AMBE- 20x0™ HDK is also a stand-alone voice processing board, equipped with connections for analog audio I/O, a RS-232 serial UART port communication channel interface, and a RS-232 control port.

The AMBE-20x0™ HDK can demonstrate the capabilities and benefits of a low-bit-rate vocoder in real time communication systems, without investing much time in engineering. Once a new product design is complete and manufacturing begins the AMBE-20x0™ HDK can then be used to simulate actual system conditions as a quality control reference standard.

The HDK contains everything needed to begin testing and running a voice compression communication system without having to install additional hardware / software.

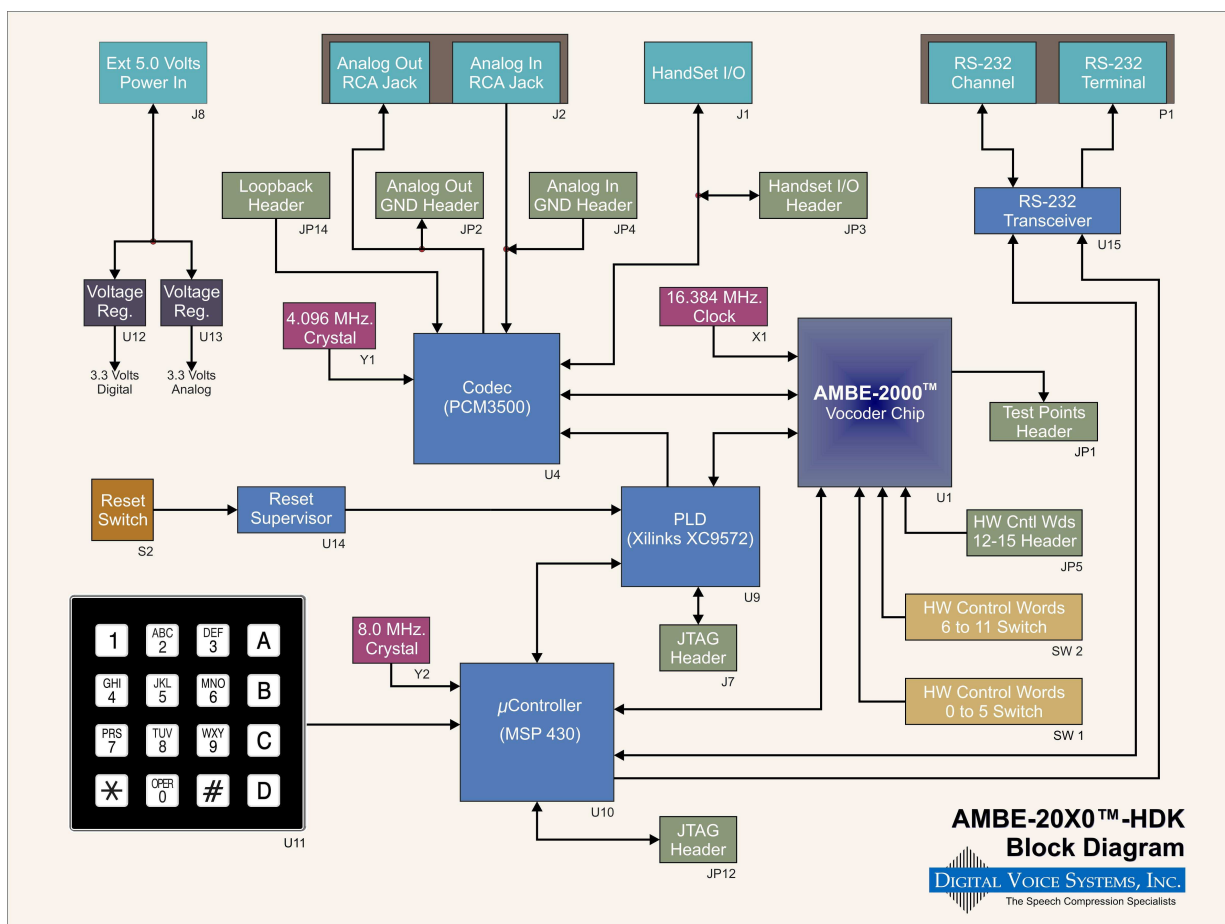


Figure 1 basic block diagram of the AMBE-2000 HDK board

The AMBE-2000™ has a master clock frequency of 16.384 MHz delivered via a surface mount crystal.

AMBE-2000™ inside

The AMBE-2000™ Vocoder Chip provides a real-time, full-duplex implementation of DVSI's standard-setting Advanced Multi-Band Excitation AMBE® voice compression technology. This technology patented by DVSI has been proven to outperform CELP and other competitive technologies. Numerous evaluations have shown its ability to provide performance equal to today's digital cellular systems at less than half the data rate.

With the AMBE-2000™ on-board the AMBE-20x0 HDK™ offers a number of features, such as: compression rates from 2000 bps to 9600 bps, soft decision FEC decoding (up to eight bits), Voice Activity Detection (VAD), Silence Frame (DTX), adaptive Comfort Noise Insertion (CNI) and support for DTMF tones.

AMBE-2000™ Vocoder Chip Applications

AMBE-2000™ Vocoder Chip Applications
Cellular Telephony and PCS Satellite Communications Digital Mobile Radio Secure Communications Voice Multiplexing Voice Mail Multimedia Applications Video Conferencing Documentation

Table 2 AMBE-2000™ Applications

Data Rates from 2000bps to 9600bps

The total coded bit rate is the sum of two components, the Speech Data bit rate and the Forward Error Correction (FEC) Data bit rate. The addition of FEC data to the speech data allows the decoder to be able to correct a limited amount of errors within each frame should they arrive corrupted. If the channel is expected to have more errors then more bits should be dedicated to FEC. At the same time, voice quality will increase if the number of speech bits is increased.

The channel interface is responsible for outputting the compressed data from the encoder and inputting compressed data to the decoder. In addition to these most basic functions, the channel interface is also capable of reporting certain events, such as the detection of a DTMF tone. The channel interface can also control certain selectable functions of the AMBE-2000™, such as the voice-coding rate.

The Voice coding rate as well as the FEC coding rate can be selected individually on the AMBE-2000™ HDK. These rates are selected by using the dipswitches. The board is designed with 32 pre-configured voice/FEC rates. If rates other than these are desired then an embedded channel software command protocol can be used to configure voice and FEC rates in 50 bps increments.

FEC

FEC is a standard portion of most digital transmission systems. FEC reduces the number of transmission errors, extends the operating range, and reduces the power requirements for communications systems. System throughput is increased by eliminating the need for packet retransmissions.

The AMBE-20x0™ HDK demonstrates two different Forward Error Correction (FEC) schemes built into the the AMBE-2000™ and AMBE-2020™ chips. These schemes may be used together or independently offering a wide variety of FEC choices. This gives the user the flexibility to optimize their system for the best possible performance.

The two FEC methods in the AMBE-20x0™ HDK are block codes and convolutional codes. The chips also use an interleaving scheme that spreads around the important bits in each frame to reduce the likelihood that all of these bits get corrupted in one frame. The chip can keep track of the number of bit errors in the current decoded frame, the current bit error rate. The FEC methods in the chips can be used in many different ways offering a very flexible tool for the designer.

Voice Activation Detection (VAD)

The Voice Activation Detection (VAD) algorithm along with the Comfort Noise Insertion (CNI) feature of the AMBE-2000™ chip performs useful functions in systems trying to convert periods of silence, that exist in normal conversation, to savings in system bandwidth or power. . For more information regarding the VAD, refer to the AMBE-2000 User's Manual.

Comfort Noise Insertion (CNI)

The synthesis of a Comfort Noise frame by the decoder is not dependant on VAD being enabled. The decoder will produce a comfort noise frame if it receives an in-band silence frame (produced only by an encoder with VAD enabled). . For more information regarding the CNI, refer to the AMBE-2000 User's Manual.

Echo Cancellation

The AMBE-2000™ Vocoder Chip employs an adaptive echo cancellation algorithm to cancel echoes of the decoder output present at the encoder input. . Only the linear portion of the echo is cancelled, so circuits should be designed to minimize non-linearity's. For more information regarding the Echo canceller, refer to the AMBE-2000 User's Manual included on the AMBE-20x0™ HDK software CD.

What's Included with the HDK

The AMBE-20x0™ HDK is a complete package solution. The development kit includes the following items

- ✓ HDK evaluation board
- ✓ Power Adapter (120v AC to 5 V DC)
- ✓ Handset with cord
- ✓ Documentation CD

The documentation CD contains the AMBE-2000™ User's Manual, program code for the on board microprocessor (MSP430) (see Note) and the XILINX Programmable Logic Device and a program executable for interfacing with a PC, as well as a full set of schematics and reference circuit designs.

Note: The development tools for the MSP430 MCU are widely available and easily obtained from Texas Instruments and various sources on the web. This gives designers an opportunity to recompile the code to test other configurations. The main tool tree is a port of the GNU GCC for the MSP430. This allows for a robust development environment free of cost.

SECTION 2

Connectors, Test Points & Indicators



Overview

As a standalone development tool, the AMBE-2000™-HDK can process analog audio input and send the synthesized speech to the analog audio outputs. Alternatively, the RS-232 channel interface can be connected to a PC for processing files. The AMBE-2000™-HDK can also be connected to another AMBE-2000™-HDK via the RS-232 channel interface demonstrating its capabilities in a full-duplex communication system.

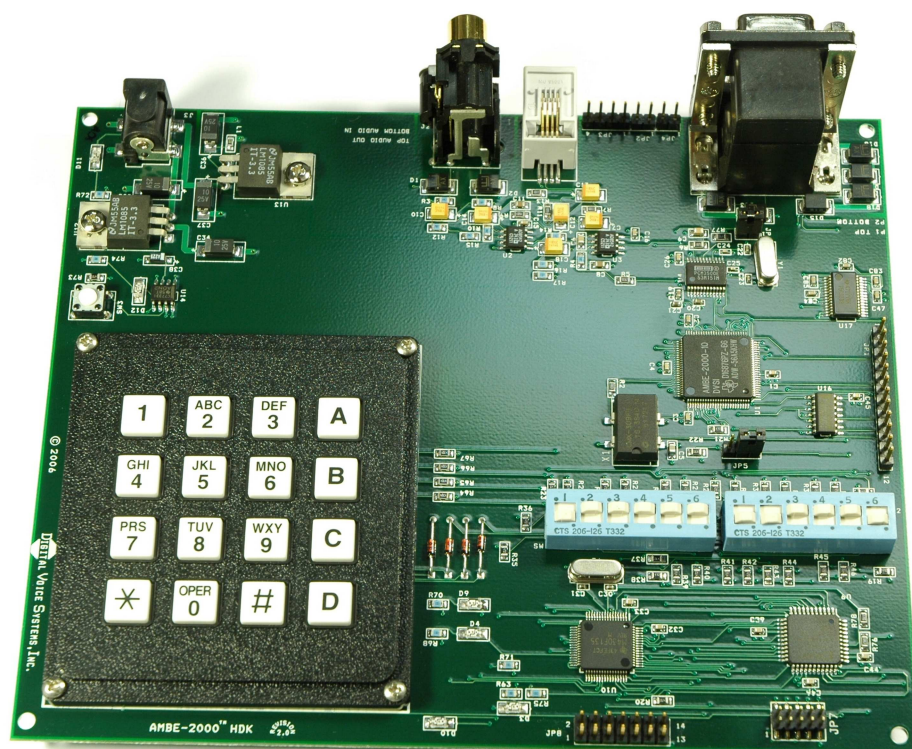


Figure 2 AMBE-20x0™-HDK Development Board Top

Additionally, the board provides test points for extensive circuit probing of hardware, instruction sets, addresses, and data. An on-board keypad and slide switches provide control of configuration parameters for maximum flexibility of vocoder features.

Board Connections0			
Item	Name	Connector Type	Description
J6	Serial Port	DB-9s	Channel Data
J3			
J2			
J1			
J5	Handset	RJ-11	Full Duplex Communication
J10	DC Line In	Power Receptacle	5 Volts DC

Table 3 Top Panel Connectors

DC Power

The AMBE-20x0™-HDK Development Board operates with a 5.0 V DC power supply. Simply plug in the 120 V AC to 5.0 V DC (~250ma) power source (provided in the HKD Kit) into the DC power receptacle (See photo in Figure 3 Power Input Connection).

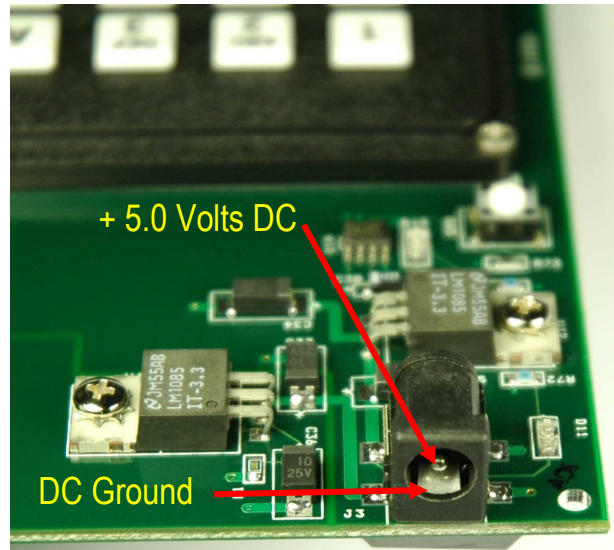
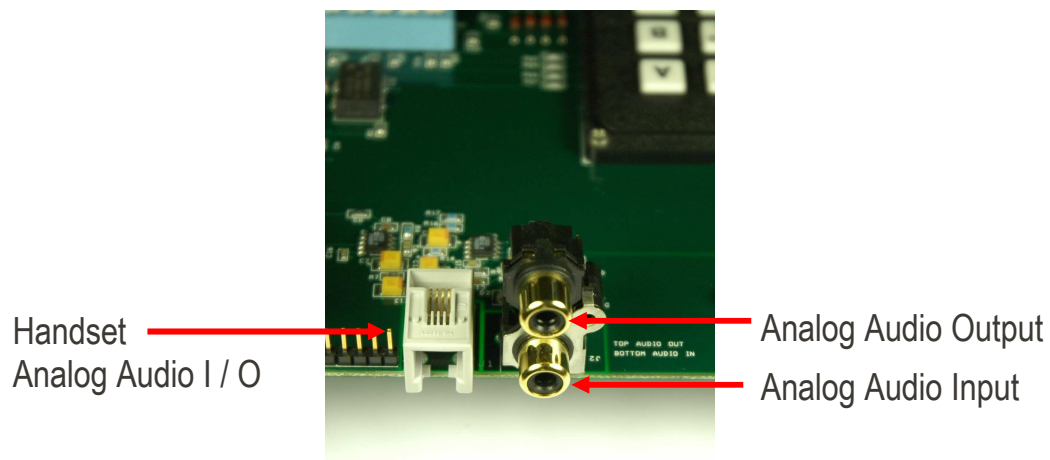


Figure 3 Power Input Connection

Analog Audio I/O

A typical analog audio input connection for the AMBE-20x0™-HDK Development Board would be to connect the audio Line output of an audio component such as, a Digital Tape, player or even a PC sound card output to the Analog Input jack (audio cables not included) of the AMBE-20x0™-HDK Development Board. The AMBE-20x0™-HDK Development Board outputs the analog signal on the output RCA jack that may be connected to an amplifier or Audio In jack on a PC sound card. The unit always outputs the audio to both the 4-Wire and Handset output regardless of the voice source selected.



Handset

If a handset is used instead of the 4 wire interface, use a standard telephone handset (included in the optional accessories kit) to connect to the RJ11 handset connector. Be sure that the handset cord is less than a foot long (included in the optional accessories kit) when not stretched. This will help reduce noise from being introduced into the voice signal. The AMBE-20x0™-HDK Development Board always outputs the audio to both the 4-Wire and Handset output regardless of which voice source is selected.

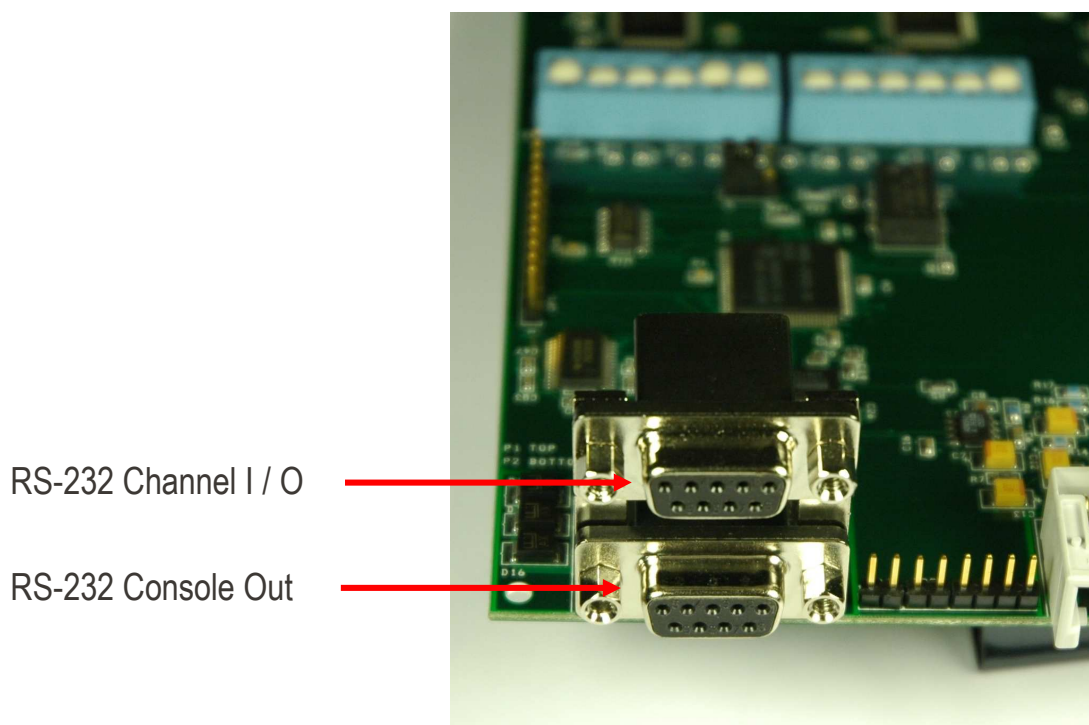
Handset Header JP3	
Pin Number	Name
1 and 2	Connected internally to Ground
3	Speaker Out
4	Microphone In/DC Microphone Bias out

Table 4 Handset PinOut

RS-232 Connections

There are two RS-232 connection on the HDK board. (see photo) The top connector is the channel output that can be used to communicate to another HDK board or to connect to an PC for recording or playback to / from a file.

The MSP-430 has a master clock of 8 MHz. The auxiliary clock (for USART operation) operates at 1.048 MHz.



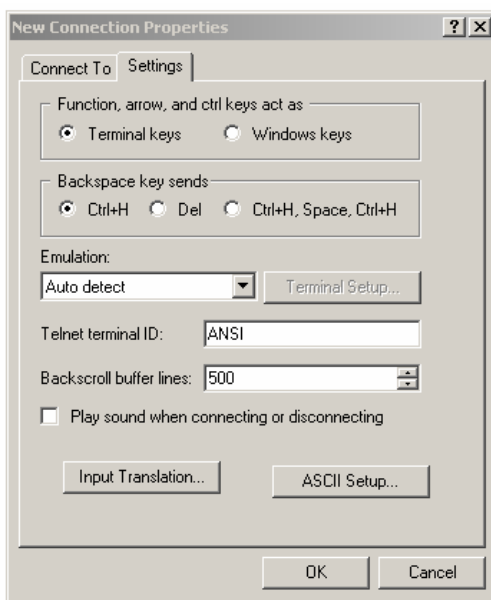


Figure 4 ConsoleTerminal Settings

Channel I/O

The channel connection on the HDK Board is an asynchronous RS-232 interface for connecting directly to a serial device or another HDK Board. When two HDK boards are connected together to communicate, each converts the input analog speech into digital speech samples, encodes the speech using the selected vocoder rate and then sends the compressed bit stream out as serial data packets over the RS-232 interface. Simultaneously, the compressed bit stream from the other HDK are read in from the RS-232 interface and decoded back in to digital speech samples. The decoded samples are converted back into analog speech via the codec whose output is sent to both the handset and RCA line-level output connections.

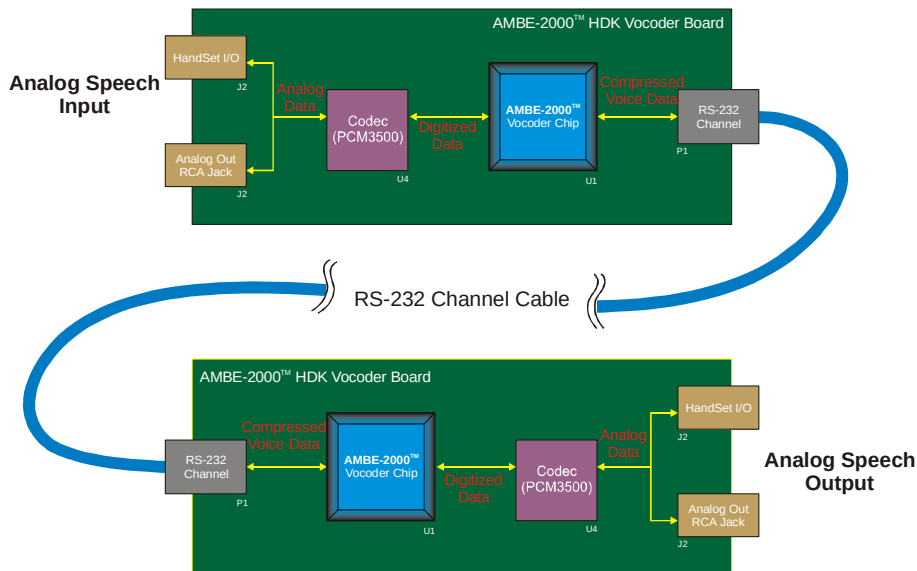


Figure 5 Connecting Two HDK Boards Together

Console Out

The bottom serial port on the HDK provides a simple ASCII text output intended for monitoring the current configuration and operation of the board. A terminal or terminal emulator on a personal computer may be used to connect the interface. Simply plug a RS-232 cable into the serial port plug the other end into your terminal (or one of the serial ports on your PC if you are using an emulator) and set the terminal up for 115,200 baud, eight bits, no parity, one stop bit, and no flow control.

Serial Port Settings	
Bits per second:	115200
Data bits:	8
Parity:	None
Stop bits:	1
Flow control:	None

Table 5 Console Out UART Serial Port Settings

JTAG Connections

The MSP430 JTAG connector is 2x7 pin with 0.1" step that follows the TI recommended JTAG layout. The PIN.1 is marked with square pad on bottom. MSP430-JTAG has build-in target board voltage follower and the JTAG voltage levels follow MSP430 target board voltage, so target may be powered with voltage between 2.7 and 3.6 V (if the target voltage is under 2.7V Flash memory cannot be programmed).

More information on the MSP430 JTAG can be found on Texas Instruments web site www.ti.com

MSP430 JTAG Header (JP8)	
Pins	Signal
1	TDO/TDI
2	VCC
3	TDI
4	NC
5	TMS
6	NC
7	TCK
8	NC
9	GND
10	NC
11	VCC
12	NC
13	NC
14	NC

Table 6 MSP430 JTAG Header (JP8)

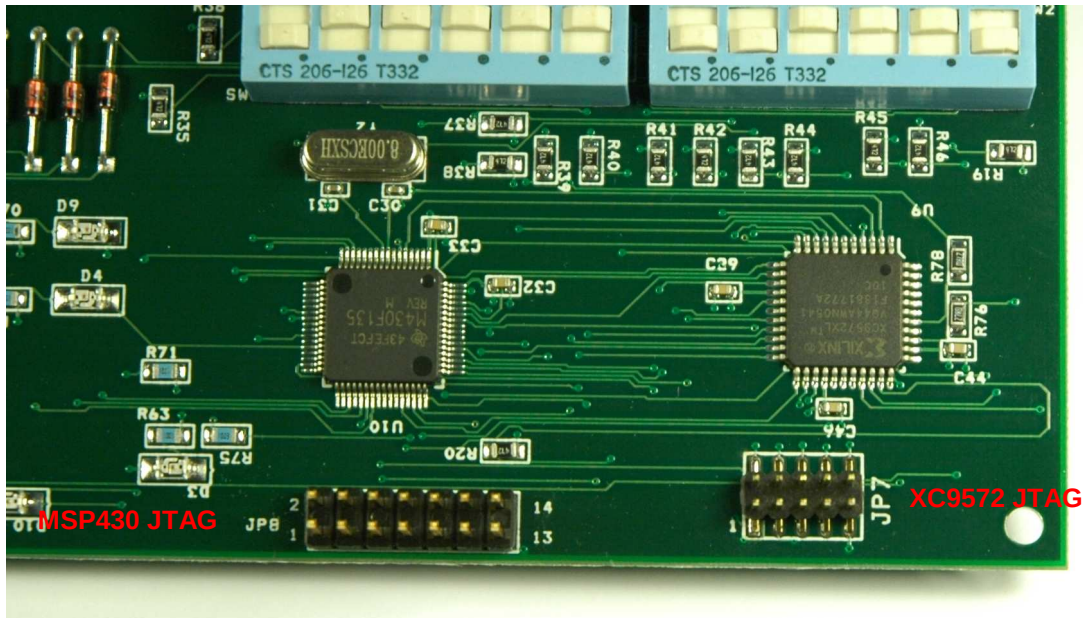


Figure 6 Photo of JTAG Connections

PLD JTAG Interface

JTAG operation for the XC9572XL consists of four signals: TMS, TDI, TDO, and TCK. These signals interact with the device through the TAP Controller, a 16-state finite state machine. The JTAG TMS signal controls transitions between states. Instructions and data are shifted into the device on the TDI pin and are shifted out on the TDO pin. All state transitions and activity on the TDI and TDO signals are synchronous to TCK

More information on the XC9572XL JTAG can be found on Xilinx web site www.xilinx.com

Header (JP7)	
Pins	Signal
1	GND
2	VCC
3	GND
4	TMS
5	GND
6	TCK
7	GND
8	TDO
9	GND
10	TDI

Table 7 PLD JTAG Pin out

Test Points

Test points allow the user to access the data to and from the AMBE-2000™. By monitoring the data flow users can better understand the operation of this chip. For more detailed explanation of the I/O signal, refer to the AMBE-2000™ Vocoder Chip Users manual.

AMBE-2000™

JP1 Header	
Pins	Signal
1	GND
2	GND
3	AMBE Channel Data OUT
4	AMBE Channel TX Strobe
5	Channel Clock
6	AMBE output PCM
7	Codec TX/RX Strobe
8	/BCK
9	AMBE input PCM
10	AMBE Channel Data IN
11	GND
12	GND

Table 8 AMBE-2000 Test Points

Analog I/O

JP2 header	
Pins	Signal
1	Analog Out (RCA)
2	GND

Table 9 Analog Test Points (JP2)

JP3 Header	
Pins	Signal
1	GND
2	GND
3	Analog OUT (Handset)
4	Analog IN (Handset)

Table 10 Analog Test Point (JP3)

JP4 Header	
Pins	Signal
1	Analog IN (RCA)
2	GND

Table 11 Analog Test Point (JP4)

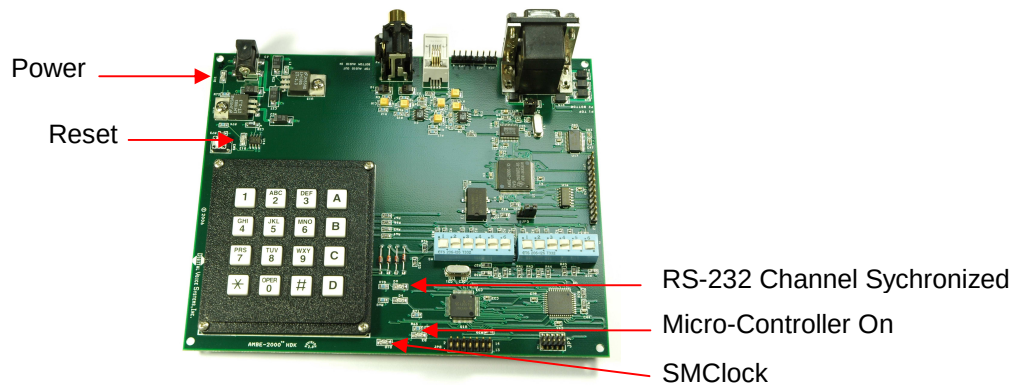
HDK Board Status Indicator LEDs

AMBE-20x0™-HDK Development Board uses LEDs' as a convenient way to display the current condition of Audio I/O, vocoder and communications channel to the operator.

The LCD indicators indicate the status of the board as follows

LED ID	Description (when LED ON)
D3	Micro controller on
D4	AMBE Packet Format (HDK Packet format when OFF)
D9	Channel is Synchronized
D10	SM Clock
D11	Power Applied
D12	Reset (goes off when Reset Switch is pressed)

Table 12 Board Status LED's



SECTION 3

HDK Configuration & Data Rate Selection



Overview

The AMBE-2000™ Vocoder settings are determined by both the DIPswitch and Jumper positions. The Dipswitch positions are always read upon board power up or after a the Reset Button is pressed.

Board Reset

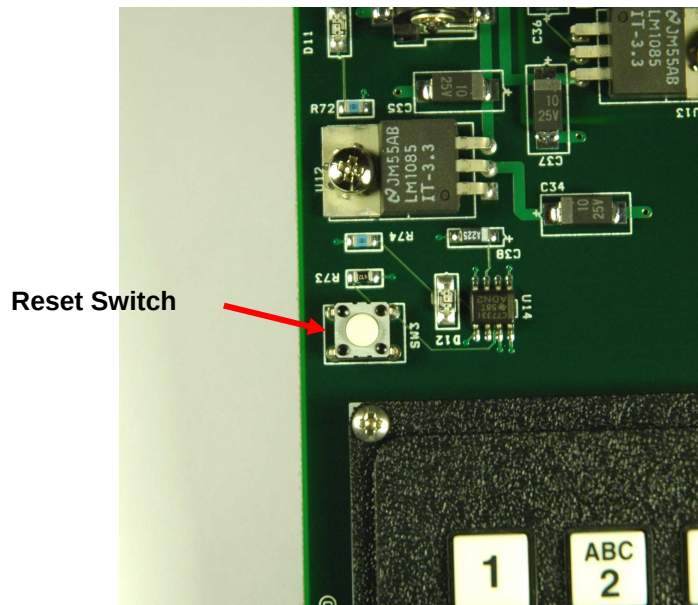


Figure 7 Reset Switch

AMBE-2000™ Vocoder Set-up via Dip-Switches

The hardware DIPswitches and Jumper JP5 allow the user to set one of 32 standard AMBE-2000™ Vocoder Chip rates and configure the chips features. In order for a new setting to take effect Reset Switch must be pressed or the power to the board cycled.

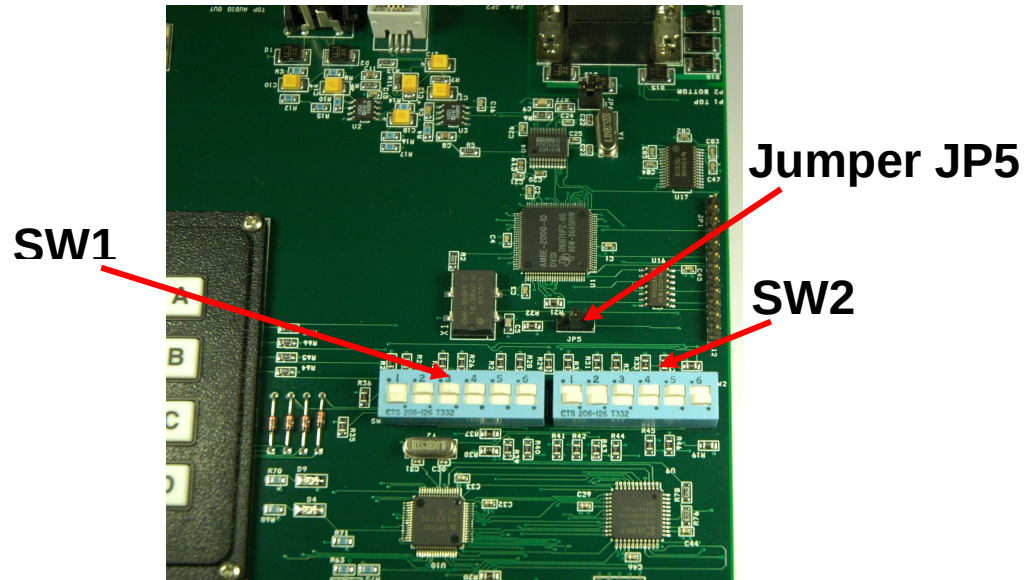


Figure 8 Vocoder Settings Switches SW1 and SW2

Slide Dip-Switch Settings

Switch SW1 and SW2 Description			
	Down Position	Up Position	
D1-1	See Table Table 14 Standard Rate Table for AMBE-20x0		RATE_SEL0
D1-2			RATE_SEL1
D1-3			RATE_SEL2
D1-4			RATE_SEL3
D1-5			RATE_SEL4
D1-6	See Table Table 15 Channel Interface Selection Table		CHAN_SEL0
D2-1			CHAN_SEL1
D2-2	Active	Inactive	ECHOCAN_EN
D2-3	Inactive	Active	SOFT_EN
D2-4	See Table Table 16 Unframed Bit per Word Selection Table		BAUD_SEL0
D2-5			BAUD_SEL1
D2-6	Inactive	Active	SLIP_EN

Table 13 Dip Switches 1 and 2 Settings

Total Rate (bps)	Speech Rate (bps)	FEC Rate (bps)	Switch 1 Settings for Positions 1-5				
			Pos 1	Pos 2	Pos 3	Pos 4	Pos 5
2000	2000	0	Down	Down	Down	Down	Down
2400	2400	0	Up	Up	Up	Up	Up
	2350	50	Down	Up	Down	Up	Up
3600	3600	0	Down	Up	Up	Up	Up
	3350	250	Down	Down	Up	Down	Up
3600	3600	0	Up	Up	Up	Up	Down
4000	4000	0	Down	Down	Down	Down	Up
	3750	250	Up	Down	Down	Down	Up
4000	4000	0	Down	Up	Up	Up	Down
	2400	1600	Up	Down	Down	Up	Down
4800	4800	0	Down	Down	Up	Up	Up
	4550	250	Down	Down	Down	Up	Up
	3600	1200	Up	Down	Up	Up	Up
	3100	1700	Up	Up	Up	Down	Up
4800	4800	0	Up	Down	Up	Up	Down
	4000	800	Up	Up	Up	Down	Down
	3600	1200	Down	Down	Down	Up	Down
	2400	2400	Down	Up	Up	Down	Down
6400	4150	2250	Up	Down	Up	Down	Up
6400	6400	0	Down	Down	Up	Up	Down
	4000	2400	Up	Down	Up	Down	Down
7200	4400	2800	Down	Up	Up	Down	Up
7200	4400	2800	Down	Down	Up	Down	Down
8000	7750	250	Up	Down	Up	Down	Up
	4650	3350	Down	Down	Up	Down	Up
8000	8000	0	Up	Up	Down	Up	Down
	4000	4000	Up	Up	Down	Down	Down
9600	9600	0	Up	Up	Down	Up	Up
	4850	4750	Up	Down	Down	Up	Up
9600	9600	0	Down	Up	Down	Up	Down
	3600	6000	Up	Down	Down	Down	Down
	2400	7200	Down	Up	Down	Down	Down

Table 14 Key

Rate Selection compatible w/ AMBE-1000™ (AMBE™ Rates)

Rate Selection for AMBE-2000™ only (AMBE+™ Rates)

Table 14 Standard Rate Table for AMBE-20x0

Channel Interface Selection		
	Switch 1 Position 6	Switch 2 Position 1
	CHAN_SEL1 (AMBE-2000™ pin 77)	CHAN_SELO (AMBE-2000™ pin 75)
Active Framed	Down	Down
Active Unframed	Down	Up
Passive Framed*	Up	Down
Passive Unframed*	Up	Up
*Note: Passive Framed and Passive Unframed packet type may be implemented in a future update.		

Table 15 Channel Interface Selection Table

Number of voice data bits per word		
	Switch 2 Position 4	Switch 2 Position 5
	BAUD_SEL1 (AMBE-2000™ pin 81)	BAUD_SELO (AMBE-2000™ pin 80)
1	Down	Down
2	Down	Up
3	Up	Down
4	Up	Up

Table 16 Unframed Bit per Word Selection Table

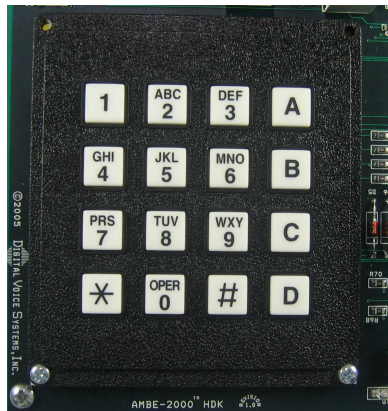
Jumpers

JP5	
Pins	Signal
Jumper on Pin 1	VAD EN
Jumper on Pin 3	VAD Disable

Table 17 Jumper Settings

HDK RS-232 Interface Set-up via Keypad

HDK board RS-232 channel Interface configuration and Packet format may be set through the use of the keypad. In order to receive confirmation on the keypad selections the console monitor RS-232 cable must be connected from the bottom DB9 connector and to a PC. Once the connection is established open up a terminal window and press # to get the PC or dumb terminal to respond with a menu of configuration options. See Connecting the Console Out UART Serial Connection to a PC in the next section.



SECTION 4

Communication via Channel Interface



Overview

AMBE-20x0™-HDK board has two RS-232 connections that provide communication to and from the board. The top connector is the RS-232 channel interface that provides the compressed voice serial data bit stream. The RS-232 Channel I / O is an asynchronous serial interface that uses a protocol designed by DVSI. A real-time, full-duplex communication link can be established by connecting a cable to this connector on both units.

The board can encode data from either the handset or 3.5mm stereo jack (Line In) connections. Which ever source is used the analog speech signal is first digitized by the on-board A-to-D converter and then processed by the encoder and converted into a Formatted Data bit stream. This compressed bit stream which contains the respective data bit stream (the data rate depends on the software setting) will be output to the RS-232 interface.

The HDK Board Decodes the encoded data received from the RS-232 connection and then plays it back through the 16-bit D-to-A converter to the handset or output jack. The encoder and decoder are fully asynchronous.

Basic Operation

The AMBE-20x0™-HDK Development Board provides the ability to encode and decode speech at compression rates between 2.0 kbps to 9.6 kbps. The HDK encodes analog speech input from the handset or RCA jack input connections and decodes compressed voice data from the RS-232 interface.

Analog speech from the RCA jacks or handset is digitized by the on board PCM3500 A/D-D/A (The PCM3500 has a master clock speed of 4.096 MHz. and is configured for an 8 kHz sampling frequency) and then sent to the AMBE-2000™ where it gets encoded into compressed digital data. This data may be output to the channel interface, or loopbacked to the RCA jacks or handset depending on the user settings.

THE HDK provides two modes of operation. The default mode "HDK Mode" is where the HDK takes the configuration setting from the onboard switch setting and processes incoming analog speech from either the handset or RCA jack inputs. Once the incoming speech has been processed and encoded it is then sent out via the RS-232 channel interface. The format of the serial output is explained below. The other mode of operation is the AMBE-2000™ Mode" in this mode of operation the incoming speech is handle the same but the format of the encoded data stream over the RS-232 interface contain the complete packet structure as in the AMBE packet.

When the board is configured to use the RS-232 interface the AMBE-2000™ Formatted Data bit stream is output to the PC and can be stored in a file. The file format for the encoded speech (BITFILE with a .bit suffix) is 16 bit little endian.

The AMBE-20x0™-HDK Development Board can decode a previously generated BITFILE. When the HDK receives compressed digital data from the BITFILE over the RS-232 channel interface it is processed by the AMBE-2000™ Vocoder Chip decoder and synthesized into a digital speech signal that is then converted into an analog signal using the onboard D-to-A and then sent to the handset / RCA jacks. The encoder and decoder are fully asynchronous.

When power is applied to the board, the HDK sets the configuration of the AMBE-2000 vocoder chip to the setting as set by the dipswitches. This allows to the board to keep the configuration setting in between power cycling or after pressing reset.

To set the HDK into AMBE Packet Format the user must connect the console output cable to a PC open a terminal window press “#” in order to get a menu to print to the screen. This menu will indicate the current status and configuration of the hdk. To set a new setting press the corresponding number on the keypad and the console monitor will indicate the new configuration setting.

NOTE any setting set thru the keypad is stored in volatile memory, this means that if reset is pressed or power is cycled any configuration settings that were set through the keypad will be lost. Anytime reset is press or power is cycled, the HDK reverts to the configuration settings as set by the dipswitches.

“HDK Format” Packet Data Structure

Data packets sent as byte-aligned frames over the asynchronous RS-232 UART Serial interface. This helps maintains compatibility with asynchronous 8N1 framing and synchronization if channel errors exist.

The first word is the sync element. It holds the 16-bit identification (0x13EC) of the start of the packet. The packet sync value of the first word is always the same. The second 16 bit word contains the first word of the compressed data. The total number of bits in the packet depends upon the voice compression data rate. In the “HDK Format”, the total packet length will vary depending on the compressed data rate selected. If a data rate is selected that results in the last word being not completely filled then the HDK will add zeros to fill in the end of the word. Also, as different data rates are selected the HDK will “auto-baud” the RS-232 baud rate. “Auto-baud” helps maintain channel efficiency by setting the RS-232 baud rate to the lowest rate possible to accommodate the transmitted data.

“HDK Mode” Packet Structure		
Word	Contents	Description
0	Header / Sync Word	Hex Value 0x13EC
1	Compressed Voice Channel Data	
2	...	
3	...	Last Word for $2000 < \text{rates} \leq 2400$ bps
...	...	
6	...	Last Word for $4000 < \text{rates} \leq 4800$ bps
...	...	
...	...	
...	...	
13	Compressed Voice Channel Data	Last Word for $8000 < \text{rates} \leq 9600$ bps

Table 18 “HDK Format” Packet Structure

Compressed Voice Bit Rate	Compressed voice Number of data bits	Total Packet Length (Number of channel data words including sync word)
2000	40	4
2400	48	4
3000	60	5
3600	72	6
4000	80	6
4200	84	7
4400	88	7
4800	96	7
7200	144	10
8000	160	11
9600	192	13

Table 19 Example Packet Size for Various Compressed Voice Data Rates

Data Structure “AMBE-2000 Format” Packet

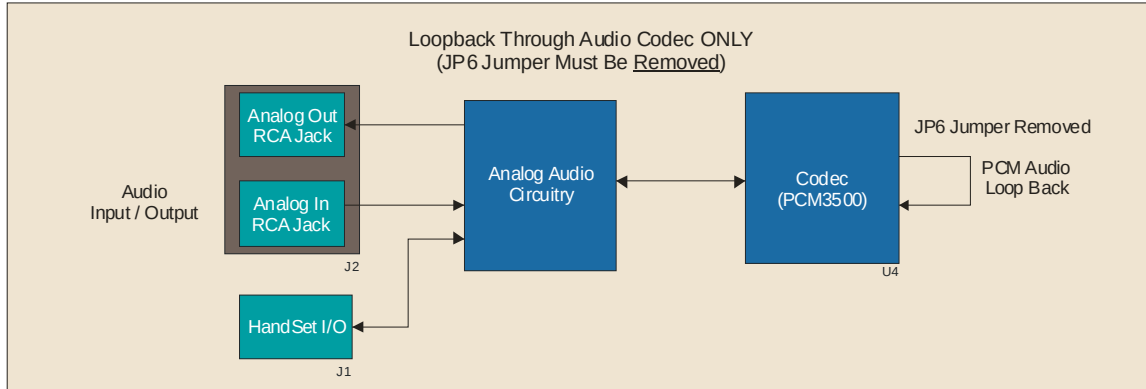
The data structure in AMBE-2000 format contain the all 24 16-bit words that are output from the AMBE-2000™ vocoder packet as describe in the AMBE-2000™ vocoder chip users Manual. The HDK can only enter into AMBE-2000 format by using the console monitor and selecting the “B” option and then the “1” option from the command menus. All setting in AMBE-2000 format are stored in volatile memory an are not save after a board reset or a power cycle.

		Word #	Description
20 ms frame	24 sixteen-bit words = 48 bytes = 384 bits	0	Header always set to 0x13EC
		1	Power Control ID (8bits) Control Word 1 (8 bits) – see Table 5-B
		2	Rate info 0
		3	Rate info 1
		4	Rate info 2
		5	Rate info 3
		6	Rate info 4
		7	Unused in Input
		8	Unused in Input
		9	Unused in Input
		10	DTMF Control – see Tables 5-E and 5-F
		11	Control Word 2 – see Table 5-G
	(12) 16 bit words of data (192 bits)	12	Channel Data
		13	Channel Data
		14	Channel Data
		15	Channel Data
		16	Channel Data
		17	Channel Data
		18	Channel Data
		19	Channel Data
		20	Channel Data
		21	Channel Data
		22	Channel Data
		23	Channel Data

HDK Audio Codec Loop Back

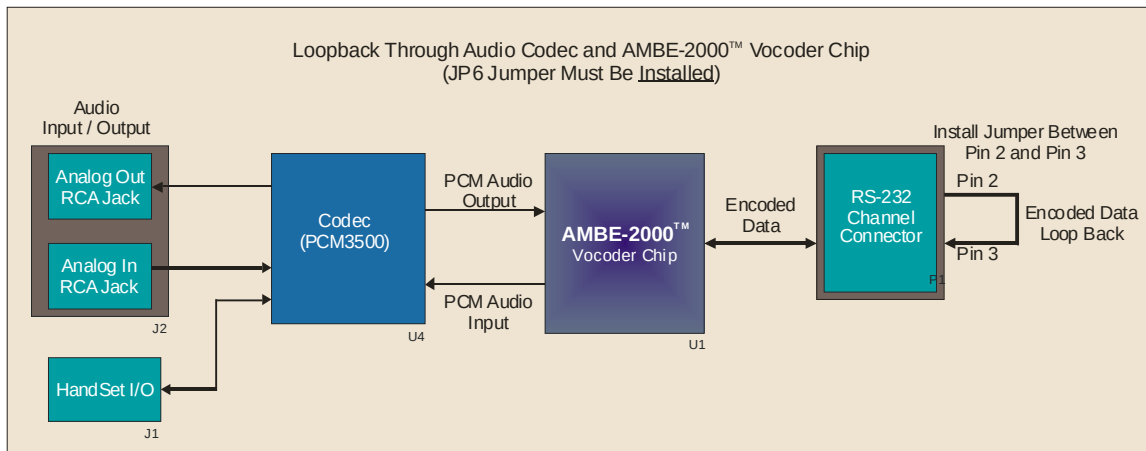
The AMBE-2000™ HDK can run in a standalone nature. The audio interface is able to be looped back so that the input audio (from the handset or line in) goes through the codec only and the result is heard at the output. To loopback only through the codec **remove the Jumper on JP6**. Then input audio will go through the AD/DA process and output the handset and line out.

NOTE: Be sure to replace the Jumper on JP6 after running in audio codec loopback.



Loop Back HDK Audio Codec and AMBE-2000™ Vocoder Chip

Audio from the handset or line can be loop back through the AD/DA Codec and the AMBE-2000™ Vocoder chip. To do this jumper Pin 2 to Pin 3 of the RS-232 Channel Connect (top DB9S connector) on the AMBE-2000™ HDK. Then the input audio will go through the codec, the vocoder, to the RS-232 connection where it is looped back through the jumper (Pins 2 to 3) to the AMBE-2000™ Vocoder chip, back to the codec and out the handset and line out.



Connecting two Boards together via RS-232 Channel I/O

The AMBE-2000™ HDK can be directly connected to a second AMBE-2000™ HDK via the channel interface creating a full duplex channel between the two boards. When connected, the analog voice from the first AMBE-20x0™-HDK Development Board is encoded and sent across the RS-232 channel interface. At the second AMBE-20x0™-HDK Development Board, the incoming channel packets of coded speech is decoded and played out on the handset or analog line output. At the same time the second AMBE-20x0™-HDK Vocoder board can encode speech from the analog input and send it across the RS-232 channel to be decoded by first AMBE-20x0™-HDK Development Board

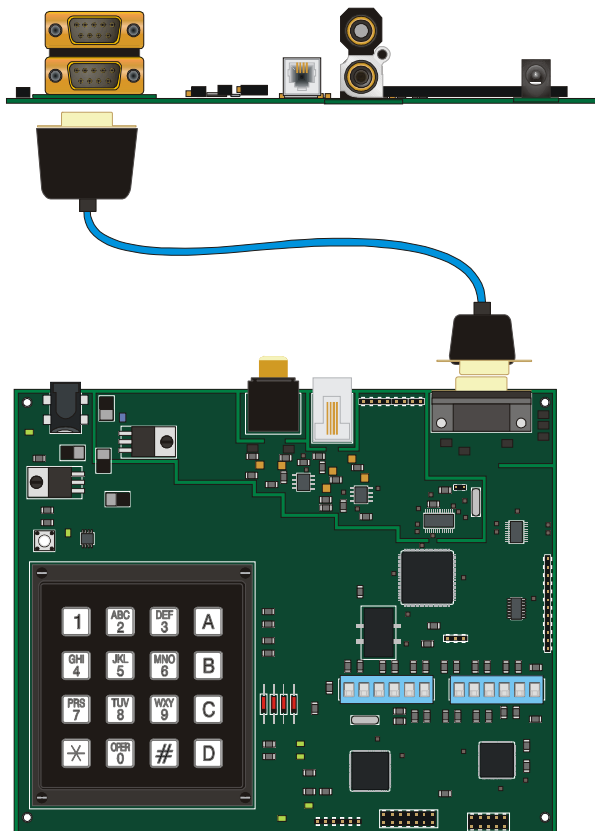


Figure 9 Connecting two HDK boards together using a null modem RS-232 cable.

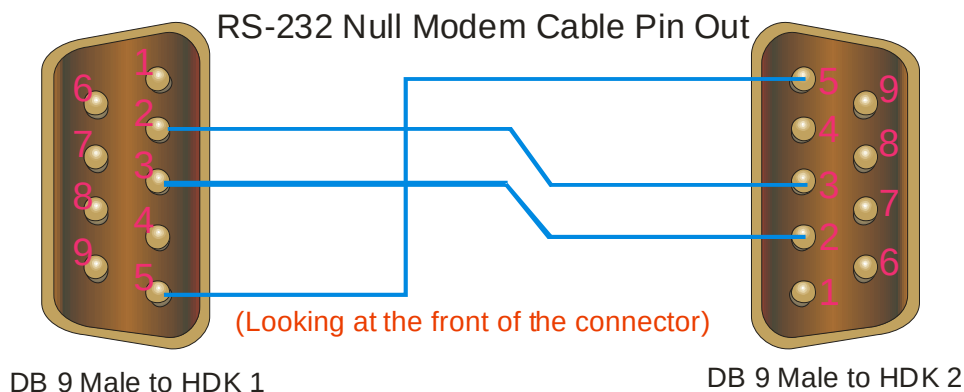


Figure 10 RS-232 Null Modem Cable Pin-out for connecting two HDK boards together

Connecting the Console Out UART Serial Connection to a PC

The bottom RS-232 port connector outputs information for monitoring the configuration and state of the AMBE-20x0™-HDK Vocoder board to console or a PC. For Console Out interface settings refer to Table 5 Console Out UART Serial Port Settings page 10.

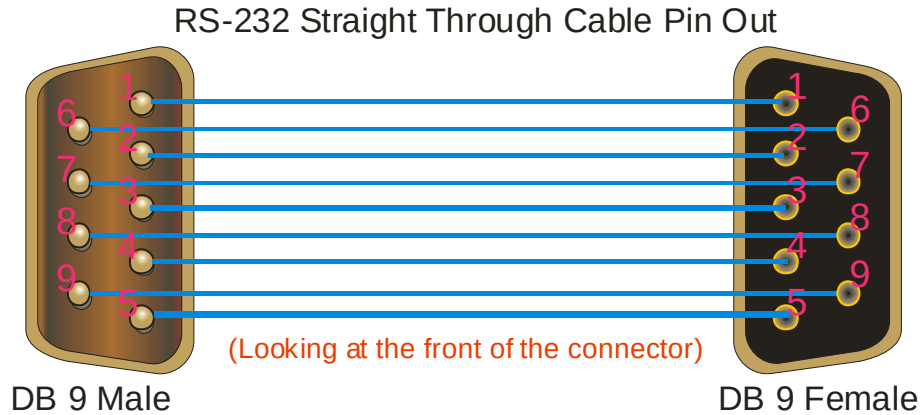


Figure 11 RS-232 Straight through Cable Pin-out for connecting HDK Board and PC together

Once a RS-232 interface is connected between the
By pressing the # key the HDK will respond with two options for configuring the board.

Press A to Select Channel RS-232 Baud Rate
Press B to Select Channel Packet Format
Press * to Exit

To configure the Channel RS-232 baud rate PRESS A. The HDK will respond with the following menu for selection of the channel data rate.

Line	Display Item	Description
1	RS-232 Baud Rate Selection Page	Menu title
2	Current Baud Rate = XX	Current rate as shown in line 4 and 5 (indexed)
3	Minimum Baud Rate = XX	Minimum rate the channel can operate as shown in line 4 and 5 (indexed)
4	Press 0-4: For Baud Rates 4800, 7200, 9600, 14400, 19200 respectively	Available rates. To select a rate use the following values 0 = 4800 baud 1 = 7200 baud 2 = 9600 baud 3 = 14400 baud 4 = 19200 baud 5 = 28800 baud 6 = 38400 baud 7 = 57600 baud 8 = 76800 baud 9 = 115200 baud
5	Press 5-9: For Baud Rates 28800, 38400, 57600, 76800 115200 respectively	
6	Press Digit to Select Rate, then Press * to Exit	Comment that provides the user with helpful information.
7	Autobaud will be turned off	When selecting a specific RS-232 channel rate the “auto-baud” feature is turned off. To turn Auto-baud back on Press Board Reset.

After making a selection press “*” and the board will print to screen

Current RS-232 Baud Rate = XXXXXX
Current Format = XXXXX Packet

To configure the Channel Data format PRESS B. The HDK will respond with the following menu for selection of the channel data format.

Line	Display Item	Description
1	Channel Packet Format Selection Page	Menu title
2	Current Format = XXX Packet	Current Format of channel data is as shown in line 3 and 4
3	Press 0 for HDK Packet Format, then Press * to Exit	Available Formats. To select the mode use the following values 00 = HDK Packet Format (sync word and data only) 01 = AMBE-2000™ Packet Format (full AMBE-2000™ Vocoder Chip Packet)
4	Press 1 for AMBE-2000 Packet Format, then Press * to Exit	

After making a selection press “*” and the board will print to screen new HDK board current settings.

Current RS-232 Baud Rate = XXXXXX
Current Format = XXXXX Packet

Option	Name	Description
RS-232 Channel Baud Rate Configuration Options (A)		
0	RS-232 Channel Rate	4800 baud
1		7200 baud
2		9600 baud
3		14400 baud
4		19200 baud
5		28800 baud
6		38400 baud
7		57600 baud
8		76800 baud
9		115200 baud
Packet Format Options (B)		
0	HDK Format	Sync word and data only
1	AMBE-2000™ Packet Format (default setting)	Full AMBE-2000™ Vocoder Chip Packet

Connecting the RS-232 Channel I/O to a PC

Demonstration Software

The CD included with the HDK kit includes a PC executable program (ambe_hdk.exe) that enables the user to, compress and record analog speech input data to a PC, or decode a previously encoded file and play it out of the analog outputs.

The AMBE-20x0™-HDK Development Board software includes the following exe file that should be copied from the CD into a user created directory the located on a C-drive named \hdk:

ambe_hdk.exe

Also included on the HDK CD disk are sample files of compressed speech files recorded at various rates as well as PCM files that may be played through a PC's sound card and input into the audio in to create your own recorded files.

Running the ambe_hdk.exe file

To record and playback encoded file the HDK must be running in AMBE-2000 packet format and dip switched SW1 and SW2 must be set as shown in Table 20 Dip Switch Settings for File I/O. Also, the VAD must be enabled (Jumper JP5 set between Pin 1 and Pin 2). To put the HDK into AMBE-2000 Packet format refer to **Error! Reference source not found.** Section.

Dip Switch Settings Required to run ambe_hdk exe file											
SW1						SW2					
Pos 1	Pos 2	Pos 3	Pos 4	Pos 5	Pos 6	Pos 1	Pos 2	Pos 3	Pos 4	Pos 5	Pos 6
As Required to set data rate (Up or Down)					Up	Down	Up	Up	Up	Up	Down

Table 20 Dip Switch Settings for File I/O

To run the program open a command prompt window and change to the directory that has the program file in it and type ambe_hdk.exe with the desired command line options as follows:

The ambe_hdk.exe program is set to default to recording the analog input to a file named record.bit.

Command Line Options

Option	Name	Variables	Description
Channel Mode Options			
	Encode voice to file	-r<filename>	Record mode
	Decode file to audio	-t<filename>	Playback mode

Table 21 File I/O Command Line Options

Note: To record and playback encoded files the HDK must be running in AMBE-2000 packet format. If board reset is pressed or if the HDK board's power is cycled it will revert back to the default AMBE Packet Format setting.

RECORD MODE Example: Record to file named abc_voice.bit command. In a Command Prompt window go to the directory containing (C:\hdk) the ambe_hdk.exe file and type

```
ambe_hdk.exe -rabc_voice.bit
```

The program will respond with

```
A Test Port COM 1
B Test Port COM 2
C Test Port COM 3
D Test Port COM 4
E Test Port COM 5
F Test Port COM 6
G Test Port COM 7
H Test Port COM 8
X EXIT
```

SERIAL PORT TESTING - Enter Selection >

Then enter the letter (“a” thru “h” or “x”) that corresponds to the serial port you are connected to and press ENTER

The program will respond with

Port = COM1 (the com port you selected)

Mode = Record (Indicating record mode)

Record File = abc_voice.bit

Press any key to exit (When a key is pressed recording is stopped and the number of packets recorded is indicated below)

packets recieved = XXXX (counting the number of recorded packets)

File Complete

XXXX Packets recorded (the total number of packets recorded)

PLAYBACK MODE (transmit) Example: Playback of file named abc_voice.bit command type

ambe_hdk.exe -tabc_voice.bit

The program will respond with

```
A  Test Port COM 1
B  Test Port COM 2
C  Test Port COM 3
D  Test Port COM 4
E  Test Port COM 5
F  Test Port COM 6
G  Test Port COM 7
H  Test Port COM 8
X  EXIT
```

SERIAL PORT TESTING - Enter Selection >

Then enter the letter (“a” thru “h” or “x”) that corresponds to the serial port you are connected to and press ENTER

The program will respond with

Port = COM1 (the com port you selected)

Mode = Playback (indicating playback mode)

Playback file = abc_voice.bit

File Complete (playback finished)

XXXX Packets sent (the total number of packets played back)

SECTION 5

Specifications

Overview



This section contains hardware Specifications of the AMBE-20x0™-HDK Development Board.

NOTE: All specifications subject to change.

Board Connections

Serial Port 1 Channel Data (top connector)	
Type	RS-232 asynchronous
Connector	

RS 232 Serial Port Pin Out	
Pin Number	Name
1	Connected to Pin 6
2	Tx Channel Out
3	Rx Channel In
4	RTS
5	CTS
6	Connected to Pin 1
7	Connected to Ground
8	Connected to Ground
9	No Connection

Serial Port 2 Console Monitor Out (bottom connector)	
Type	RS-232 asynchronous
Connector	

RS 232 Serial Port Pin Out	
Pin Number	Name
1	Connected to Pin 6
2	Tx Console Out
3	Rx Console In
4	RTS
5	CTS
6	Connected to Pin 1
7	Connected to Ground
8	Connected to Ground
9	No Connection

Audio I/O Connections

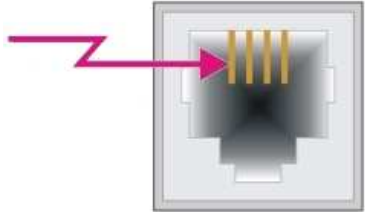
Line In	
Type	Single-ended Input
Connector	female 3.5mm Audio Jack
Maximum Input Level:	1.41 Volts RMS
Input Impedance	10 ohms nominal
Bandwidth	20 Hz to 4 kHz (up to 48 kHz).

	available)
D/A Resolution	16 bits
D/A Sampling Rate:	8 kHz (up to 96kHz. available)
SNR (Non-Weighted)	81 dB

Note: A 1.414 V signal on the line input produces digital max when the codec input gain is 0 dB.

Line Out	
Type:	Single-ended Output
Connector:	female 3.5mm Audio Jack
Maximum Output Level	1.0 Volt RMS
Output Impedance:	<50 Ohms
Bandwidth:	20 Hz to 3.6 kHz (up to 48 kHz. available)
A/D Resolution:	16 bits
SNR (Non-Weighted)	84 dB
A/D Sampling Rate:	8 kHz (up to 96kHz. available)
Minimum Load	10k Ohms nominal

Handset:	
Type:	Single-ended
Connector:	RJ 4P4C
Bandwidth:	20 Hz to 4 kHz
A/D Sampling Rate:	8 kHz
A/D Resolution:	16 bits

Handset Pin Out (RJ11 Connector)		
Pin Number	Signal Name	
1 and 2	Connected to Ground	
3	Speaker Out	
4	Microphone In/DC Microphone Bias out	

Handset Header JP3	
Pin Number	Name
1 and 2	Connected to Ground
3	Speaker Out
4	Microphone In/DC Microphone Bias out

Header Connections

J15 DSP JTAG			
Pin Number	Name	Pin Number	Name
1	TMS	8	Digital Ground
2	TRSTn	9	TCK
3	TDI	10	Digital Ground
4	Digital Ground	11	TCK
5	Sys_3v3	12	Digital Ground
6		13	EMU0
7	TDO	14	EMU1

Electrical Input

J10 Power	
Pin Number	Name
Center	+5 Volts DC
Shield	Ground

DC Power	
Input Voltage	5 Volts DC
Input Current	250 ma @ 5V DC

Mechanical

Mechanical	
Weight	5.3 oz. (with connectors installed)
Size (W X D X H)	6.75"X 5.5"

JTAG Connections Setup & Control

JP14	
Pins	Signal
Jumper Off	Codec Loop back
Jumper On	Normal Operation

SECTION 6

Additional Resources

Third Party Tools



MSP-430 Flash Programmer

Part Number: MSP-PRGS430

<http://focus.ti.com/docs/toolsw/folders/print/msp-prgs430.html>

Xilinx Platform Cable USB

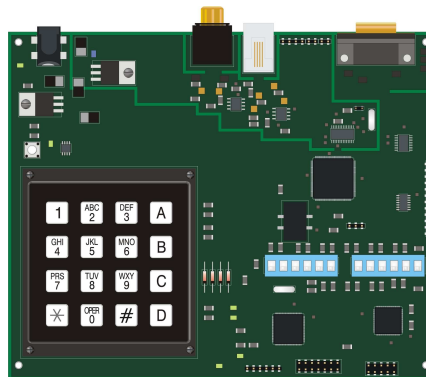
Part Number: DLC9

http://www.xilinx.com/xlnx/xebiz/designResources/ip_product_details.jsp?key=HW-USB&iLanguageID=1

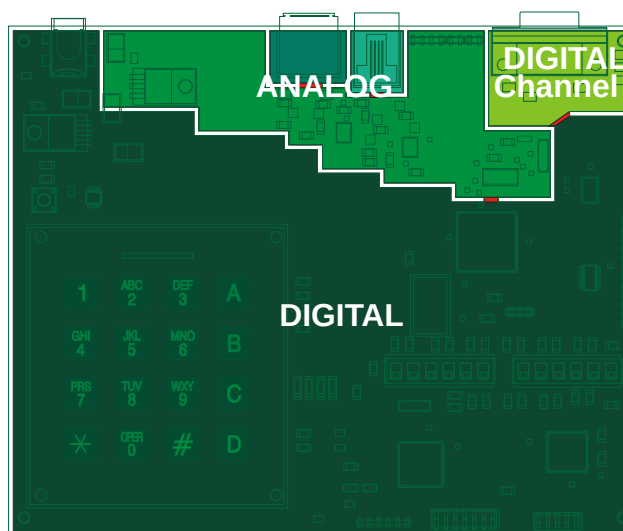
MSPGCC MSP-430 GNU Compiler

<http://mspgcc.sourceforge.net/>

Printed Circuit Board Layout Diagram



Printed Circuit Board Ground Planes



Schematics

MSP430 Input/Output Pin Description

MSP430 Input/Output Pin Description

Pin No.	I/O Port Bank	Port No.	Input/Output	Description
12	P1	0	I	KB 0
13		1	I	KB 1
14		2	I	KB 2
15		3	I	KB 3
16		4	I	TX_SWITCH
27		5	I	RX_FULL
18		6	I	TX_EMPTY
19		7	I	SER_DAT_FS

20	P2	0	I	SER_DATA_CLK
21		1	O	SER_DATA_TX
22		2	I	SER_DATA_RX
23		3	I	AMBE_EPR
24		4		N/C
25		5		N/C
26		6		N/C
27		7		N/C

28	P3	0	O	LED
29		1	O	LED_EN
30		2	O	LED_CTL
31		3	O	SHIFT_TX
32		4	O	TX_DATA_OUT
33		5	I	RX_DATA_IN
34		6	O	SHIFT_RX
35		7	O	LED

Pin No.	I/O Port Bank	Port No.	Input/Output	Description
36	P4	0		KB
37		1		KB
38		2		KB
39		3		KB
40		4	O	LED_0
41		5	O	LED_1
42		6	O	LED_2
43		7	O	LED_3

44	P5	0	I	RX_DATA_0
45		1	I	RX_DATA_1
46		2	I	RX_DATA_2
47		3	I	RX_DATA_3
48		4	I	RX_DATA_4
49		5	I	RX_DATA_5
50		6	I	RX_DATA_6
51		7	I	RX_DATA_7

59	P6	0	O	TX_DATA_2
60		1	O	TX_DATA_1
61		2	O	TX_DATA_0
2		3	O	TX_DATA_3
3		4	O	TX_DATA_4
4		5	O	TX_DATA_5
5		6	O	TX_DATA_6
6		7	O	TX_DATA_7

XILINX PLD Input/Output Pin Description

PIN	Input/Output	Description
1	O	AMBE_*RESET
2	I	TX_DATA_7
3	I	TX_DATA_6
4		GND
5	I	TX_DATA_5
6	I	TX_DATA_4
7	I	TX_DATA_3
8	I	TX_DATA_2
9	JTAG	TDI
11	JTAG	TCK
12	I	TX_DATA_1

13	I	TX_DATA_0
14	O	RX_DATA_7
15		VCC
16	O	RX_DATA_6
17		GND
18	O	RX_DATA_5
19	O	RX_DATA_4
20	O	RX_DATA_3
21	O	RX_DATA_2
22	O	RX_DATA_1
23	O	RX_DATA_0
24	JTAG	TDO
25		GND
26		VCC
27	O	RX_FULL
28	O	TX_EMPTY
29	I	AMBE_CHAN_DX
30	O	AMBE_CHAN_DR
31	O	AMBE_CHAN_FS
32	I	SHIFT_RX
33	I	*POWER_ON_RESET
34	I	MSP430_RESET
35		VCC
36	O	CHAN_CLK
37	I	SHIFT_TX
38	O	DIGIT_0
39	O	DIGIT_1
40	I/O	N/C
41	I	LED_EN
42	I	LED_CTL
43	I	BCK_BUFF
44	O	PCM3500/PDWN

Software Development

Software development will be accomplished by using the freely available GCC (Gnu Compiler Collection). This will give the purchaser an opportunity to compile code for them and to make changes to the provided code to test other configurations. GCC was chosen because it can be obtained free of charge. There are also versions available for most modern programming environments.

Reference Designs

Application Information

It is strongly recommended that the user review the Application Information provided in the Texas Instruments PCM3500 data sheet before finalizing any design.

Additional Reference Material

AMBE-2000™ or AMBE-2020™ vocoder chip Users Manual
<http://www.dvsinc.com/literature.htm>

Application Report – Understanding Data Converters:
<http://www-s.ti.com/sc/psheets/slaa013/slaa013.pdf>

PCM3500 Data Sheet
<http://www-s.ti.com/sc/ds/pcm3500.pdf>

PCM3500 Evaluation Board
<http://www-s.ti.com/sc/psheets/sbau028/sbau028.pdf>

SECTION 7

Support



DVSI Contact Information

If you have problems or questions about the AMBE-20x0™-HDK Development Board please contact:

Digital Voice Systems, Inc.
234 Littleton Road
Westford, MA 01886 USA

Phone: (978) 392-0002
Fax: (978) 392-8866

email: info@dvsinc.com
web: www.dvsinc.com

Support engineers are available
Monday through Friday, 9:00 AM to 5:00 PM eastern time and can be contacted by:
Phone: (978) 392-0002
Fax: (978) 392-8866
Email: info@dvsinc.com
World Wide Web: <http://www.dvsinc.com>

History of Revisions			
Revision Number	Date of Revision	Description	Page
1	8-25-06	Edits to Serial, MSP430, and Xilinx Schematics	32,33,34
2	12-06-06		
		Added RS-232 cable Pin out drawings Fig. 10 and Fig. 11	25
3	1-3-07	Edited Table 14 to clearly identify between AMBE™ and AMBE+™ Data Rates	16
		Added note to Table 15	16
4	7-9-07	Revised Table 14 rate 6400 speech 0 FEC to be Down Down Up Up Down	16
5	9-19-07	Revised page 21 to include more details on loop back	21

NOTES

